

**Department of the Army
Mobile District, Corps of Engineers**

**STANDARD OPERATION PROCEDURE (SOP),
COMPENSATORY STREAM MITIGATION GUIDELINES**

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COMPENSATORY STREAM MITIGATION GUIDELINES

1. GENERAL INFORMATION:

Compensatory mitigation for linear aquatic systems (streams) will require some form of stream restoration or enhancement action. Activities that constitute restoration/enhancement include, but are not limited to: stream channel restoration; bank stabilization; in stream habitat recovery; impoundment removal; livestock exclusion devices; road crossing improvements; and natural buffer establishment. **A minimum of 30% of needed credits must be generated by enhancement or restoration activities.** All of these restoration/enhancement measures should be designed with the goal of improving habitat, biological and morphological integrity, and water quality. Stream Mitigation means the manipulation of the physical, chemical, or biological characteristics of a stream with the goal of repairing natural/historic functions of degraded stream, resulting in a gain in stream functions.

1.1. Regulatory Authorities & Guidelines

Section 10 of the River and Harbor Act of 1899: In accordance with Section 10 of the River and Harbor Act, the Corps of Engineers is responsible for regulating all work in navigable waters of the United States.

Section 404 of the Clean Water Act: In accordance with Section 404 of the Clean Water Act as amended in 1977, the Corps of Engineers is responsible for regulating the discharge of dredged or fill material in waters of the United States, including wetlands. The purpose of the Clean Water Act is to restore and maintain the physical, chemical, and biological integrity of the nation's waters. **Section 230.10 (d) of the Section 404 (b)(1) Guidelines** states that "... no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem." The Section 404 (b)(1) Guidelines requires application of a sequence of mitigation -- avoidance, minimization and compensation. In other words, mitigation consists of the set of modifications necessary to avoid adverse impacts altogether, minimize the adverse impacts that are unavoidable and compensate for the unavoidable adverse impacts. Compensatory mitigation is required for unavoidable adverse impacts, which remain after all appropriate and practicable avoidance and minimization has been achieved. The Guidelines identify a number of "Special Aquatic Sites," including riffle pool complexes, which require a higher level of regulatory review and protection. This stream guidance document addresses only compensatory mitigation and should only be used after adequate avoidance and minimization of impacts associated with the proposed project has occurred.

Regulatory Guidance Letter (RGL) 02-02 - Guidance on Compensatory Mitigation Projects for Aquatic Resource Impacts Under the Corps Regulatory Program Pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. This guidance requires compensatory mitigation to replace aquatic resource functions unavoidably lost or adversely affected by authorized activities. RGL 02-02 provides important guidance on compensatory mitigation including requiring increased use of functional assessment tools, improved performance standards, and a stronger emphasis on monitoring with the purpose of improving the success of compensatory mitigation projects.

2. ADVERSE IMPACT FACTORS:

Streams are complex ecosystems with morphological characteristics that are dependent on appropriate geomorphic dimension, pattern, and profile as well as biological and chemical integrity. They are not simply stormwater conveyances. The following factors will determine the amount of mitigation credits required:

2.1. Stream Types: **Perennial Streams** flow water most of the time in most years. **Intermittent Streams** flow water part of the time in most years and have a defined stream channel. **Ephemeral Streams** flow water in response to heavy rainfall events.

2.2. Priority Area: Priority area is a factor used to determine the importance of the water body proposed to be impacted or used for mitigation. Priority areas are influenced by the quality of the aquatic habitat potentially subject to be impacted or used for mitigation. The priority area factor will influence the amount of stream credits generated. The priority areas are divided into three categories:

Primary: These areas provide important contributions to biodiversity on an ecosystem scale or high levels of function contributing to landscape or human values. Impacts to these areas should be rigorously avoided or minimized. Compensation for impacts in these areas should emphasize replacement nearby and in the same immediate 8-digit watershed. Designated primary priority areas include:

- Waters with Federal or State listed species,
- National Estuarine Research Reserves,
- River sections in approved greenway corridors,
- Wild and Scenic Rivers,
- Outstanding National Resource Waters,
- Outstanding State Waters,
- Essential Fish Habitat

Secondary: Secondary priority areas include:

- Waters with Federal Species of Management Concern or State listed rare or uncommon species,
- Secondary trout streams (Put and Take Fishery),
- Waters adjacent to Federal or State protected areas or Corps' approved mitigation banks,
- Waters on the 303(d) list,
- State Heritage Trust Preserves,
- Anadromous fish spawning habitat,
- Designated shellfish grounds,
- Stream and river reaches within 0.5 mile upstream or downstream of primary priority reaches,
- Stream or river reaches within high growth areas that aren't ranked as primary priority systems,
- Stream or river reaches within 0.5 miles of a groundwater recharge area,
- Stream or river reaches within 0.5 miles of a drinking water withdrawal site

(For the purposes of this stream SOP, a stream reach is the length of a stream section containing a complete riffle and pool complex. If none noted, a suitable length is usually no less than 300 feet long)

Tertiary: These areas include all other freshwater or tidally influenced lotic systems not ranked as primary or secondary priority.

2.3. Existing Condition: The state of the physical, chemical and biological health of a stream at the time of an assessment, as compared to the least disturbed condition of similar streams in the ecoregion. This is a measure of the stability and functional state of a stream and the stability of the riparian buffer before project impacts.

Fully functional stream means that the physical geomorphology of the reach is stable and is representative of an appropriate stream hydrograph for the topographical setting. The biological community is diverse and unimpaired by excessive anthropogenic inputs; streams with listed species, primary trout streams, and streams identified as highly diverse are considered fully functional. For purposes of these guidelines, a fully functional stream is one that has not been channelized; has no culverts, pipes, impoundments, or other in-stream manmade structures on site; has no more than one stream reaches within 0.5 miles upstream that have been culverted, piped, or otherwise modified by manmade structures (less than 30' of impacted section); has an appropriate entrenchment ratio and width/depth ratio at bankfull discharge relative to unimpaired stream condition; shows little evidence of human-induced sedimentation; and has at least a minimum width riparian buffer (see definition below) of deep-rooted vegetation on both sides of the stream.

Somewhat Impaired stream means that stability and resilience of the stream or river reach has been compromised, to a limited degree, through partial loss of one or more of the integrity functions (chemical, physical, biological). System recovery has a moderate probability of occurring naturally. For purposes of these guidelines, a stream segment is considered somewhat impaired if the entrenchment ratio and/or width/depth ratio at bankfull discharge is inappropriate relative to unimpaired stream conditions; human-induced sedimentation is moderate; a moderate riparian buffer of deep-rooted vegetation is present (minimum of at least 10 feet on both sides of the stream); and/or no more than 3 reaches within 0.5 mile upstream of the evaluated stream segment have been culverted, piped, or otherwise modified by manmade structures (with less than 100' of impacts).

Impaired stream means that there is a very high loss of system stability and resilience characterized by loss of one or more integrity functions. Recovery is unlikely to occur naturally, with further damage is likely, unless restoration is undertaken. For purposes of these guidelines, a stream is considered impaired if the reach has been channelized or if the entrenchment ratio and/or width/depth ratio at bankfull discharge is inappropriate relative to unimpaired stream condition; has extensive human-induced sedimentation; has little or no riparian buffer with deep-rooted vegetation on one or both sides of the stream; has banks that are extensively eroded or unstable; and/or ≥ 5 reaches within 0.5 miles upstream have been culverted, piped, channelized, impounded, or otherwise modified by manmade structures.

2.4. Duration: Duration is the amount of time adverse impacts are expected to last.

Temporary means impacts will occur within a period of less than 6 months and recovery of system integrity will follow cessation of the permitted activity.

Recurrent means repeated impacts of short duration (such as with on-channel 24-hour stormwater detention).

Permanent means project impacts will be permanent or will occur during spawning or growth periods for Federal and State protected species.

2.5. Dominant Impact:

Armor means to riprap, bulkhead, or use other rigid methods to contain stream channels.

Below Grade (embedded) Culvert means to route a stream through pipes, box culverts, or other enclosed structures (≤ 100 LF of stream to be impacted per crossing). The below grade culverts should be designed to pass bankfull flow, and greater than bankfull flow to be passed through other culverts within the floodplain. The culvert bottom including head-walls and toe-walls would be designed to be embedded to a depth of no less than 12 inches below ground line. If rock runs throughout the culvert area, a bottomless culvert should be used. Improperly designed culverts will be evaluated under Dominant Impact Factor for piping. Culverts should be designed to allow fish passage and allow other natural stream processes to occur unimpeded.

Clearing means clearing of streambank vegetation or other activities that reduce or eliminate the quality and functions of vegetation within riparian habitat without disturbing the existing topography or soil. Although these impacts may not be directly regulated, mitigation for these impacts may be required if the impact occurs as a result of; or in association with, an activity requiring a permit.

Detention means to temporarily slow flows in a channel when bankfull is reached. Areas that are temporarily flooded due to detention structures must be designed to pass flows below bankfull stage.

Fill means permanent fill of a stream channel due to construction of dams or weirs, relocation of a stream channel (even if a new stream channel is constructed), or other fill activities.

Impound means to convert a stream to a lentic state with a dam or other detention/control structure that is not designed to pass normal flows below bankfull stage. Impacts to the stream channel where the structure is located is considered fill, as defined above.

Morphologic change means to channelize, dredge, or otherwise alter the established or natural dimensions, depths, or limits of a stream corridor.

Pipe means to route a stream for more than 100' through pipes, box culverts, or other enclosed structures.

Utility crossings mean pipeline/utility line installation methods that require disturbance of the streambed.

2.6. Cumulative Impact Factor : Cumulative impact factor means the length of stream, in feet, that will be impacted by a project, as authorized under Section 404 of the Clean Water Act, and for which mitigation will be required.

3. MITIGATION CREDITS:

3.1. In-Stream Activity

3.1.1. Net Benefit: Net benefit is an evaluation of the proposed mitigation action relative to the restoration, enhancement, and maintenance of the chemical, biological, and physical integrity of the Nation's waters. Four stream restoration methods are covered under these guidelines - stream channel restoration/streambank stabilization, stream relocation, riparian restoration, and riparian preservation. ***The Corps will determine, on a case-by-case basis,*** the net benefit of mitigation actions that do not involve direct manipulation of a length of stream and/or its riparian buffers, such as retrofitting stormwater detention facilities, implementation of county ordinances regarding buffer protection, construction of off-channel stormwater detention facilities in areas where runoff is accelerating streambank erosion, measures to reduce septic tank leakage, paving of dirt roads, contaminant reduction, stormwater surcharge reduction and other watershed protection practices. (Note: Off-channel stormwater detention facilities should not be placed in jurisdictional wetlands, forested floodplains, or riparian buffer zones.) Stream mitigation within 300 feet of a culvert, dam, or other man-made impact to waters of the United States generally will generate only minimal restoration or preservation credit due to impacts associated with these structures.

3.1.1.1. Stream Channel Restoration /Streambank Stabilization: All restored channels must be protected by at least a minimum width buffer of native vegetation on both sides of the stream. In addition, all stabilized stream banks must be protected by at least a minimum width buffer. This buffer will also generate riparian preservation or restoration mitigation credit. Credit for installation of structures described below under the Good and Moderate restoration actions will be based on 3X the length of the appropriate size structure (e.g., 600' for a 200' tree revetment). Credit for removal of structures described below under the **Excellent** and **Good** restoration actions will be based on the documented length of reach that the structure impacts under current flow conditions. All proposed stream channel restoration/streambank stabilization actions should include design criteria and explain why/how the project will benefit water quality and/or habitat.

■ **Excellent stream channel restoration actions include:**



Priority 1 Restoration - Creating floodplains of appropriate dimensions adjacent to streams with inappropriately low width/depth ratios at bankfull discharge.

Priority 2 Restoration - Restoring appropriate bankfull discharge width, stream sinuosity, entrenchment ratio, and width/depth ratio in degraded streams to referenced morphologic patterns

Removing dams and large (weirs, pipes, culverts and other manmade in-stream) structures with > 50 linear feet of direct fill/impact, then restoring the stream channel to referenced, stable morphologic patterns

The excellent mitigation credits can not be used for stream channel or stream bank restoration, if the mitigation segment is within 300 feet upstream of a dam or a channelized/piped section, that is >100 feet long, within the 300 feet section.

■ **Good stream channel restoration/streambank stabilization actions include**

Priority 3 Restoration – Converting stream type by shaping upper slopes and stabilizing both bed and banks.

Restoring streambank stability by using non-rigid methods in highly eroded areas.

Restoring in-stream channel features (i.e., riffle/run/pool/glide habitat) using methodology appropriate to stream type

Culverting floodplains at existing road crossings and replacing inappropriately sized/designed culverts to allow more natural flood flows.

Removing weirs, pipes, culverts and other manmade in-stream structures.

■ **Moderate stream channel restoration/streambank stabilization actions include:**

Priority 4 Restoration – Stabilize stream channel in place

Restoring streambank stability using non-rigid methods in moderately eroded areas

Constructing fish ladders or Adding woody debris to create fish habitat.

3.1.1.2. Priority System Restoration: Are used when restoring or improving a river that take into account a range of options based on numerous factors. Unfortunately, the most common approach in incised channel stabilization is Priority 4, often the most costly, highest risk and least desirable form of biological and aesthetic viewpoint. In many instances, however, especially in urban settings, Priorities 1 and 2 are not feasible since the floodplain has been occupied. (Stream classifications are noted in the 1996. Applied River Morphology by Rosgen, D.L. and H.L. Silvey.)

Priority 1 Restoration: Re-establish channel on previous floodplain using relic channel or construction of new morphologically stable channel at a higher elevation connected to the original floodplain. The new channel will have the dimension, pattern and profile characteristic of a stable form. Fill in existing incised channel or create discontinuous oxbow lakes that are level with new floodplain elevation.

Priority 2 Restoration: Re-establishing floodplain. Where relocation of an incised stream is impracticable, modifying the existing channel and re-establishing floodplain at their current elevation or higher to create a stable stream. If the existing meander pattern fits the proposed stable stream type, raising the channel back on each riffle reach with grade control to re-connect the floodplain is appropriate. This concept is similar to priority 1 restoration without the need to abandon the incised stream and construct a new channel.

Priority 3 Restoration: Convert the existing unstable stream to a more stable stream at the existing elevation of the channel but without an active floodplain. This involves establishing proper dimension, pattern and profile by excavating the existing channel to change stream classification (convert streams classified as F and/or G to C or E classification). This restoration concept is implemented where streams are confined (laterally contained) and physical constraints limit the use of priorities 1 and 2 restoration.

Priority 4 Restoration: Stabilize channel in place by the use of stabilization materials and methods that have been used to decrease streambed and streambank erosion including boulders, gabions and bio-engineering methods. This is a high-risk method due to excessive shear stress and velocity. Also, it limits the aquatic habitat. This is the least desirable from a biological and aesthetic standpoint. Some activities undertaken under Priority 4 Restoration may be considered adverse impacts and require compensatory mitigation.

Final stream restoration plans will be completed and presented to the Corps for review. The final plans will incorporate appropriate stream restoration techniques based on a reference stream and will be designed as required by the natural channel design methods for stream restoration and bank stabilization. These design methods will incorporate Rosgen type techniques, as well as any other non-rigid techniques. Deviation from this non-rigid methodology will have to be approved by the Corps.

3.1.1.3. Definitions of Categories of Stream Mitigation Activities:

Stream Re-establishment – is the manipulation of the physical, chemical, or biological characteristics of a stream with the goal of creating natural/historic functions to former stream. Re-establishment results in rebuilding a former stream.

Stream Restoration or Rehabilitation - is the manipulation of the physical, chemical, or biological characteristics of a stream with the goal of restoring natural/historic functions of degraded streams. Rehabilitation results in a gain in stream functions. This can be accomplished by converting an unstable, altered, or degraded stream channel / stream corridor, including adjacent riparian zone and flood-prone areas to its natural or referenced, stable conditions considering recent and future watershed conditions. **Stream channel restoration** methods should be based on measurements taken in a reference reach and may include restoration of the stream's geomorphic dimension, pattern and profile and/or biological and chemical integrity, including transport of water and sediment produced by the streams' watershed to achieve dynamic equilibrium. (Dimension includes a stream's width, mean depth, width/depth ratio, maximum depth, flood prone area width, and entrenchment ratio. Pattern refers to a stream's sinuosity, meander wavelength, belt width, meander width ratio, and radius of curvature. Profile includes the mean water surface slope, pool/pool spacing, pool slope, & riffle slope.)

Stream Stabilization - is the manipulation of the physical characteristics of stream by the stabilization of a severely eroding streambank and stream bed without consideration of reference conditions. Stabilization techniques which include "soft" methods or natural materials (such as tree revetments, root wads, log crib structures, rock vanes, vegetated crib walls and sloping of

streambanks) may be considered part of a restoration design. However, stream stabilization techniques that consist primarily of “hard” engineering, such as concrete lined channels, rip rap, or gabions, while providing bank stabilization, will usually not be considered restoration or enhancement in most cases.

Stream Enhancement – is the manipulation of the physical, chemical, or biological characteristics of a (undisturbed but degraded) stream or stream buffer to heighten, intensify, or improve specific function(s) or to change the growth stage or composition of the vegetation present. Enhancement is undertaken for a purpose such as water quality improvement and/or ecological functions (flood water retention or wildlife habitat). This can be accomplished by implementing certain stream rehabilitation practices. These practices are typically conducted on the stream bank or in the flood prone area but may also include the placement of in-stream habitat structures; however, they should only be attempted on a stream reach that is not experiencing severe aggradation or degradation. Care must be taken to ensure that the placement of in-stream structures will not affect the overall dimension, pattern, or profile of a stable stream.

3.1.2. Stream Relocation: Is moving a stream to a new location to allow a project, authorized under Section 404 of the Clean Water Act, to be constructed on the stream's former location. (Note: relocation of a stream is considered fill under these guidelines when the relocation is conducted to allow development of the area where the stream previously was located; impacts associated with stream relocation in these situations must be fully mitigated). Relocated streams should reflect the dimension, pattern and profile of natural, referenced stable conditions; maintain the capacity to transport bedload sediment; and have at least a minimum width buffer of natural vegetation on both sides of the stream to receive mitigation credit; this buffer also will generate riparian preservation or restoration mitigation credit.

3.2. Riparian Buffer Restoration and Preservation:

3.2.1. Net Benefit:

Riparian Buffer Restoration means implementing rehabilitation practices within a stream riparian buffer zone to improve water quality and/or ecological function. Buffer restoration may include increasing or improving upland and/or wetlands habitat within or adjacent to riverine systems. Restoration programs should strive to mimic the composition, density and structure of a reference reach habitat.

Riparian Buffer Preservation means the conservation, in its naturally occurring or present condition, of a riparian buffer to prevent its destruction, degradation, or alteration in any manner not authorized by the governing authority. For the purposes of these guidelines, an area will be considered as riparian buffer preservation if less than 10% of the area would require planting of deep-rooted vegetation to restore streambank stability and improve wildlife habitat. **Riparian buffer preservation may account for no more than 70% of credits generated by the mitigation plan.**

Riparian Buffer Restoration and Fencing in Actively-Grazed Pastures: Means restoring vegetation and fencing livestock from pastures, where livestock grazing activities are impacting water quality and/or stream ecological function, thereby minimizing or avoiding streambank degradation, sedimentation, and water quality problems. Livestock exclusion is

normally accomplished by fencing stream corridors and can include the construction of stream crossings with controlled access and with stable and protected stream banks

Use a 1.2 multiplier with the above table to calculate mitigation credits generated for fencing livestock from a riparian buffer with no more than one livestock crossing planned per 1,000 linear feet of stream mitigation. The width of the livestock crossing will be deducted from the total length of the stream mitigation segment. Impacted riparian buffers will have to be restored or enhanced and may not be used for preservation purposes only, after cattle have been removed.

Minimum Buffer Width: The minimum buffer width (MBW) for which mitigation credit will be earned is 50 feet on one side of the stream, measured from the top of the stream bank (i.e., the bankfull stage), perpendicular to the channel. Smaller buffers width may be allowed on a case-by-case basis for small urban streams. If topography within a proposed stream buffer has more than a 2% slope, 2 additional feet of buffer are required for every additional percent of slope (e.g., minimum buffer width with a +10% slope is 70'). Buffer slope will be determined in 50'-increments beginning at the stream bank. No additional buffer width will be required for negative slopes. For the reach being buffered, degree of slope will be determined at 100' intervals and averaged to obtain a mean degree of slope for calculating minimum buffer width. This mean degree of slope will be used to calculate the minimum buffer width for the entire segment of stream being buffered.

Tables 1 below provide appropriate Net Benefit values for the riparian restoration, enhancement and preservation mitigation worksheet. Note that on this worksheet, buffers on each bank of a given reach, generates mitigation credit separately (Stream Side A and Stream Side B).

Table 1. Riparian Buffer Restoration, Enhancement and Preservation

	% Buffer that Needs Vegetation Planted	* Buffer Restoration Exotic Removal and (51-100%) Planting	Buffer Enhancement Exotic Removal and (10-50%) Planting	** Buffer Preservation (< 10%) Planting
Buffer Width (on one side of the stream)	4X min. width	1.6	0.8	0.4
	3X min. width	1.2	0.6	0.3
	2X min. width	0.8	0.4	0.2
	*** Minimum width (50 ft)	0.4	0.2	0.1

* A minimum of Level II Monitoring is required.

** No mitigation credit will be given for only preserving impacted stream buffer.

*** Smaller buffers width may be allowed on a case-by-case basis for small urban streams

Note: Use a 1.2 multiplier to calculate mitigation credits generated for restoration and fencing livestock from a riparian buffer in actively grazed pastures.

3.2.2. System Protection Credit: Bonus mitigation credit may be generated if proposed riparian mitigation activities include minimum width buffers on both sides of a stream reach and legal protection of a fully buffered stream channel. (**Condition:** Mitigation plan provides for restoration or preservation of minimum width buffers, as defined in these guidelines, on both streambank of the reach).

3.3. **Monitoring and Contingencies:**

Monitoring and contingency plans are actions that will be undertaken during the mitigation project to measure the level of success of the mitigation work and to correct problems or failures. All projects should include contingency actions that will achieve specified success criteria if deficiencies or failures are found during the monitoring period. Monitoring is a required component of all mitigation plans and should at a minimum, address all success criteria paragraphs.

- **Level I Monitoring (Physical Monitoring):**

- **Riparian buffer preservation:** Collection of basic information on vegetation in the preserved buffer at the start and after 5 years. Minimal information to be collected should include vegetation present, % species composition, average species height and average species diameter at breast height (dbh).
- **Riparian buffer restoration:** Collection of basic information on vegetation in the buffer to be restored (if any) before mitigation is implemented and after 5 years. Minimal information to be collected should include vegetation present, % species composition, average species height and average species dbh. In addition, success of planted vegetation should be monitored at least annually, for 5 years, to determine if success criteria are met. Vegetation monitoring should include measurement of vegetation survival and growth (height, dbh or other biomass measure).
- **Stream channel restoration/streambank stabilization and stream relocation:** Initial baseline data on physical parameters in streams before mitigation is implemented and monitoring of these physical parameters at least annually, for 5 years, after mitigation is completed. Physical parameters to be measured include water temperature, DO, turbidity, pH, substrate characteristics, streambank erosion patterns, and longitudinal and cross sectional profiles at sites above, within, and below the restored reach.

- **Level II Monitoring (Physical /Biological Monitoring):** Conducting all features listed under Level I monitoring, plus

- **Riparian buffer preservation:** Monitoring biological parameters in the buffer, at least annually, for 5 years.
- **Riparian buffer restoration:** Initial baseline data on biological parameters in the buffer before mitigation is implemented and then at least annually for 5 years.
- **Stream channel restoration/streambank stabilization and stream relocation:** Initial baseline data on biological parameters in the stream before mitigation is implemented and then at least annually for 5 years.

Biological parameters to be measured include density and diversity of mammals, birds, reptiles, amphibians, fish, freshwater mussels, other macroinvertebrates and other fauna at sites within the buffer and/or stream.

- **Level III Monitoring:** Conducting all features listed under Level II monitoring, plus simultaneous collection and statistical comparison of baseline data on both physical and biological parameters in a suitable reference site (i.e., a high quality riparian buffer and/or stable stream channel) annually for 5 years. This level of monitoring is not applicable to riparian preservation.

Table 2. General criteria used to evaluate the success or failure of activities at mitigation sites and required remedial actions to be implemented should monitoring indicate failure of component.

Mitigation Component (Item)	Success (Required on action)	Failure	Action
1. Photo Reference /Sample Site Longitudinal photos Lateral photos	No substantial aggradation, degradation or bank erosion.	Substantial aggradation degradation or bank erosion.	When substantial aggradation, degradation or bank erosion occurs, remedial actions will be planned, approved, and implemented.
2. Plant Survival Survival plots Stake counts Tree counts	> 75% Survival within the planted Plots. These plots should mimic reference reach target habitat in species composition, density and structure. Survival and growth of at least 320 tree/acre through 3 years, then 10% mortality allowed in year 4 & additional 10% mortality in year 5 for 260 trees/acre through year 5.	< 75% Survival within the planted Plots. Survival of less than 320 tree/acre through 3 years, and then less than the success criteria for year 4 and 5.	Area with less than 75% coverage of target species will be re-seeded and or fertilized; live stakes and bare rooted trees will be planted to achieve desired densities.
3. Channel Stability Dimensions Longitudinal profiles Pebble count	Stable stream with pattern, profile and dimension of similar reference reach type. Minimal evidence of instability (down-cutting, deposition, bank erosion, increase in sands or finer substrate material).	Substantial evidence of instability.	When Substantial evidence of instability occurs, remedial actions will be planned, approved, and implemented.
4. Biological Indicators Invertebrate populations Fish populations	Population measurements remain the same or improve, and target species composition indicates a positive trend.	Population measurements and target species composition indicate a negative trend.	Reasons for failure will be evaluated and remedial action plans developed, approved, and implemented.

Substantial or subjective determinations of success will be made by the mitigation sponsor and confirmed by COE and review agencies.

Monitoring Level I will include only item 1.

Monitoring Level II will include items 1, 2 and may include item 3 based on the project review.

Monitoring Level III will include items 1, 2 and 3 and may include item 4 based on the project review.

In the event that success criteria (anticipated Stream SOP scores) are not met during the five-year monitoring period as determined by the Corps, corrective action or alternative mitigation shall be required. Remedial measures may include modification of site hydrology, planting of different species of trees, additional hand clearing, etc.

Contingency Plans/Remedial Actions: In the event the mitigation fails to achieve success criteria as specified in the mitigation plan, sponsor shall develop necessary contingency plans and implement appropriate remedial actions for that phase. In the event the sponsor fails to implement necessary remedial actions within one growing season after notification by the Corps of necessary remedial action to address any failure in meeting the success criteria, the Corps will notify sponsor and the appropriate authorizing agencies and recommend appropriate remedial actions.

3.4. Control: A **Conservation easement** is an interest in real property imposing perpetual limitations or affirmative obligations, the purposes of which include protecting, preserving, maintaining and managing waters of the US, riparian buffers, and uplands for their natural and environmental resources, functions, and values. The owner/permittee/bank sponsor must grant the conservation easement to a qualified third party entity.

A **Restrictive covenant** is a legal document whereby an owner of real property imposes perpetual limitations or affirmative obligations on the real property.

The conservation easement or restrictive covenant must be properly recorded with the appropriate local entity and be in compliance with Mobile District's requirements. They should be conforming to the most recent sample edition located on the Mobile District web page (<http://www.sam.usace.army.mil/op/reg/permmob2.htm>). The sample is subject to change without notice. Covenants and easements will be reviewed for acceptability on a case-by-case basis.

3.5. Credits: No credits are generated for this factor if the mitigative action in a reach is primarily riparian buffer preservation (<10% of buffer area would require planting of vegetation; see Table 1 below).

Non-Banks:

- Schedule 1:*** All mitigation is completed before the impacts occur.
- Schedule 2:*** A majority of the mitigation is completed concurrent with the impacts
- Schedule 3:*** A majority of the mitigation will be completed after the impacts occur.

Banks: Release of credits will be determined by the MBRT on a case-by-case basis.

3.6. Mitigation Factor: It is recommended that stream mitigation be conducted on free flowing streams. However, if a stream segment to be used for mitigation is located within 1 mile of the upstream end of an existing or proposed man made lake and feed in to it, then mitigation credits for this segment of stream will be reduced by 50%. **Use mitigation factor of 0.5 for the above mitigation sits.**

Use mitigation factor of 1.0 for all other mitigation.

4. GEOMORPHIC DEFINITIONS:

- **Bankfull Discharge** is the flow that is most effective at moving sediment, forming or removing bars, forming or changing bends and meanders, and doing work that results in the average morphologic characteristics of channels (Dunne and Leopold 1978). The bankfull stage is the point at which water begins to overflow onto a floodplain. Bankfull may not be at the top of the streambank in incised or entrenched streams. On average, bankfull discharge occurs approximately every 1.5 years.
- **Bankfull width** is the width of the stream channel at bankfull discharge, as measured in a riffle section.
- **Channel Dimension** is the stream's cross-sectional area (calculated as bankfull width multiplied by mean depth at bankfull). Changes in bankfull channel dimensions correspond to changes in the magnitude and frequency of bankfull discharge that are associated with water diversions, reservoir regulation, vegetation conversion, development, overgrazing, and other watershed changes. Stream width is a function of occurrence and magnitude of discharge, sediment transport (including sediment size and type), and the streambed and bank materials.
- **Channel Features:** Natural streams have sequences of riffles and pools or steps and pools that maintain channel slope and stability and provide diverse aquatic habitat. A **riffle** is a bed feature where the water depth is relatively shallow and the slope is steeper than the average slope of the channel. At low flows, water moves faster over riffles, which provides oxygen to the stream. Riffles are found entering and exiting meanders and control the streambed elevation. **Pools** are located on the outside bends of meanders between riffles. The pool has a flat slope and is much deeper than the average channel depth. Step/pool sequences are found in high gradient streams. **Steps** are vertical drops often formed by large boulders or downed trees. Deep pools are found at the bottom of each step.
- **Entrenchment Ratio** is an index value that describes the degree of vertical containment of a river channel. It is calculated as the width of the flood-prone area divided by bankfull width.
- **Flood-prone Area Width** is measured in the field at an elevation twice-maximum depth at bankfull. Maximum depth is the difference between the bankfull stage and thalweg elevations in a riffle section.
- **Mean Depth at Bankfull** is the mean depth of the stream channel cross-section at bankfull stage as measured in a riffle section.
- **Reference Reach/Condition** - A stable stream reach generally located in the same physiographic ecoregion, climatic region, and valley type as the project that serves as the blueprint for the dimension, pattern, and profile of the channel to be restored.
- **Sinuosity and Stream Pattern:** Stream pattern describes the view of a stream channel as seen from above. Streams are rarely straight; they tend to follow a sinuous path across a

floodplain. Sinuosity of a stream is defined as the ratio of channel length/valley length. In addition to slope, the degree of sinuosity is related to channel dimensions, sediment load, streamflow, and the bed and bank materials.

- **Stable Stream:** A naturally stable stream channel is one that maintains its dimension, pattern, and profile over time such that the stream does not degrade or aggrade. Naturally stable streams must be able to transport the sediment load supplied by the watershed. Instability occurs when scouring causes the channel to incise (degrade) or when excessive deposition causes the channel bed to rise (aggrade).
- **Stream Profile:** The profile of a stream refers to its longitudinal slope. At the watershed scale, channel slope generally decreases in the downstream direction with commensurate increases in streamflow and decreases in sediment size. Channel slope is inversely related to sinuosity, so steep streams have low sinuosities and flat streams have high sinuosities.
- **Width/Depth Ratio** is an index value that indicates the shape of the channel cross-section. It is the ratio of the bankfull width divided by the mean depth at bankfull.

Other Enhancement: The Corps, in consultation with the MBRT and other resource and regulatory agencies, will determine, on a case-by-case basis, the net benefit of mitigation actions that do not involve direct manipulation of a length of stream and/or its riparian buffers. These may include actions such as retrofitting stormwater detention facilities, construction of off channel stormwater detention facilities in areas where runoff is accelerating stream bank erosion and other watershed protection practices.

**ADVERSE IMPACT
FACTORS FOR RIVERINE SYSTEMS WORKSHEET**

Stream Type Impacted	Intermittent 0.1			1 st or 2 nd Order Perennial Stream 0.8			>2 nd Order Perennial Stream 0.4		
Priority Area	Tertiary 0.1			Secondary 0.4			Primary 0.8		
Existing Condition	Impaired 0.1			Somewhat Impaired 0.8			Fully Functional 1.6		
Duration	Temporary 0.05			Recurrent 0.1			Permanent 0.3		
Dominant Impact	Shade/Clear 0.05	Utility Crossing 0.15	Below Grade Culvert 0.3	Armor 0.5	Detention /Weir 0.75	Morpho-logic Change 1.5	Impound-ment (dam) 2.0	Pipe >100' 2.2	Fill 2.5
Cumulative Impact Factor	<100' 0	100'-200' 0.05	201-500' 0.1	501-1000' 0.2	>1000 linear feet (LF) 0.1 reach 500 LF of impact (example: scaling factor for 5,280 LF of impacts = 1.1)				

Factor	Dominant Impact Type 1	Dominant Impact Type 2	Dominant Impact Type 3	Dominant Impact Type 4	Dominant Impact Type 5
Stream Type Impacted					
Priority Area					
Existing Condition					
Duration					
Dominant Impact					
Cumulative Impacts Factor					
Sum of Factors	M =				
Linear Feet of Stream Impacted in Reach	LF=				
M X LF					

Total Mitigation Credits Required = (M X LF) = _____

**IN-STREAM WORK
STREAM CHANNEL /STREAMBANK RESTORATION AND RELOCATION
WORKSHEET**

Stream Type	Intermittent 0.05	1 st or 2 nd Order Perennial Stream 0.4	>2 nd order Perennial Stream (Bankfull width)			
			>15' 0.4	15'-30' 0.6	30'-50' 0.8	>50' 1.0
Priority Area	Tertiary 0.05		Secondary 0.2		Primary 0.4	
Existing Condition	Impaired 0.4		Somewhat Impaired 0.05			
Net Benefit	Stream Relocation 0.1		Stream Channel Restoration/Streambank Stabilization			
			Moderate 1.0	Good 2.0	Excellent 3.5	
Monitoring/ Contingency	Level I 0.05	Level II 0.3		Level III 0.5		
Control	Restrictive Covenant 0.1			Conservation Easement 0.4		
Credits	Schedule 1 0.3	Schedule 2 0.1		Schedule 3 0		

Factors	Net Benefit 1	Net Benefit 2	Net Benefit 3	Net Benefit 4	Net Benefit 5	Net Benefit 6
Stream Type						
Existing Condition						
Net Benefit						
Monitoring/ Contingency						
Priority Area						
Control						
Credits						
Sum Factors (M)=						
Stream length in Reach (do not count each bank separately) (LF)=						
Credits (C) = M X LF						
Mitigation Factor Use (MF) = 0.5 or 1.0						
Total Credits Generated C X MF =						

Total Channel Restoration/Relocation Credits Generated = _____

RIPARIAN BUFFER RESTORATION AND PRESERVATION WORKSHEET

Stream Type	Intermittent 0.05	>2 nd Order Perennial Stream 0.2	1 st or 2 nd Order Perennial 0.4
Priority Area	Tertiary 0.05	Secondary 0.2	Primary 0.4
Net Benefit (for each side of stream)	Livestock (select values from Table 1 times 1.2 multiplier)	Riparian Restoration and Preservation Factors (select values from Table 1) (MBW = Minimum Buffer Width = 50' + 2' / 1% slope)	
System Protection Credit	Condition : MBW restored or protected on both streambanks To calculate:(Net Benefit Stream Side A + Net Benefit Stream Side B) / 2		
Monitoring/ Contingency (for each side of stream)	Level I 0.05	Level II 0.15	Level III 0.25
Control	Restrictive Covenant 0.05		Conservation Easement 0.2
Credits (for each side of stream)	Schedule 1 0.15	Schedule 2 0.05	Schedule 3 0

Factors		Net Benefit 1	Net Benefit 2	Net Benefit 3	Net Benefit 4	Net Benefit 5	Net Benefit 6
Stream Type							
Priority Area							
Net Benefit	Stream Side A						
	Stream Side B						
System Protection Credit Condition Met (Buffer on both sides)							
Monitoring/ Contingency	Stream Side A						
	Stream Side B						
Control							
Credits (none for primarily riparian preservation) < 20% requires planting)	Stream Side A						
	Stream Side B						
Sum Factors (M)=							
Linear Feet of Stream Buffer (LF)= (don't count each bank separately)							
Credits (C) =M X LF							
Mitigation Factor Use (MF) = 0.5 or 1.0							
Total Credits Generated C X MF =							

Total Riparian Restoration Credits Generated = _____